Ordering number: EN 3347

Monolithic Digital IC



No.3347

LB1689D

3-Phase Brushless Motor Driver

Applications

The LB1689D is a 3-phase brushless motor driver IC ideally suited for use in VTR capstan motor, drum motor drive applications.

Features and Functions

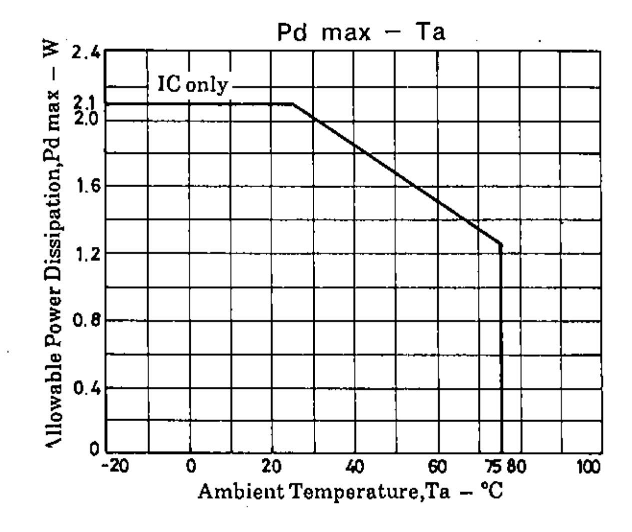
(1) 120° voltage linear type
(2) Soft switching type eliminating noises caused by current switching and making the values of external capacitors smaller (comparable to those of chip capacitors)
(3) On-chip FG amplifier
(4) On-chip thermal shutdown circuit
(5) The FG signal can be used to detect the rotational speed of a motor so that the hall amp gain is changed in two steps, thus reducing torque ripple and noise.

Absolute Maximum Ratings at Ta = 25°C

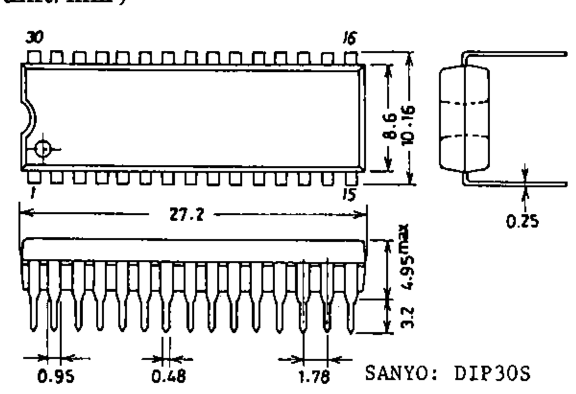
			unit
Maximum Supply Voltage	V_{CC} max1	20	V
	V_{CC} max2	7.0	V
Output Supply Voltage	$V_{OUT.V.W.}$	22	V
Output Current	I_{OUT}	1.5	A
Allowable Power Dissipation	Pd max	2.1	W
Operating Temperature	Topr	−20 to +75	°C
Storage Temperature	Tstg	−55 to +125	°C

Allowable Operating Conditions at Ta = 25°C

			unit
Supply Voltage	$V_{CC}1$	8.5 to 18	V
	$V_{CC}2$	4.3 to 6.5	V



Package Dimensions 3061
(unit: mm)



Electrical Characteristics at $Ta = 25°C, V_{CC}1 = 12V, V_{CC}2 = 5V$			min	typ	max	unit
[Power Supply]						
Supply Current 1	$I_{CC}1$	$V_C = 0, R_L = \infty$		17	30	mA
Supply Current 2	$I_{CC}2$	$V_C = 0$		6.5	9.5	mA
[Output]						
Output Saturation Voltage	$V_{O(sat)}1$	$I_{OUT} = 0.5A$, sink + source		1.6	2.2	V
	$V_{O(sat)}2$	$I_{OUT} = 1.0A$, sink + source		2.0	3.0	V
Output TRS Voltage	$V_{O(sus)}$	$I_{OUT} = 20mA$ (See note.)	20			V
Output Quiescent Voltage	V_{OQ}	$V_C = 0$	5.8	6.1	6.4	V
[Hall Input-Output]						
Hall Amp Input Offset Voltage	V_H offset		−5		+5	mV
Hall Amp Input Bias Current	I_H bias			1	5	μA
Hall Amp Common-Mode Input Voltage Range	V_H ch		1.3		3.7	V
Hall Input-Output Voltage Gain	$G_{VHO}1$			56		dB
	$G_{VHO}2$			43		dB
[Control-Output]						
Control-Output Drive Gain	G_{VCO}		38	41	44	dB
Control-Output CH Difference	ΔG_{VCO}		−2		+2	dB
[FG Amplifier]						
FG Amp Input Offset Voltage	VFG offset		−8		+8	mV
Open-Loop Voltage Gain	G_{VFG}	f = 1kHz		60		dB
Source Output Saturation Voltage	$V_{FG\,OUT}$	$I_O = 2mA$	3.7			V
Sink Output Saturation Voltage	$V_{FG\,OD}$	$I_O = -2mA$			1.3	V
Common-Mode Signal Rejection Ratio	CHR	(See note.)		80		dB
FG Amp Common-Mode Input Voltage Range	$V_{FG\,CH}$		0		3.5	V
Phase Margin		(See note.)		30		deg.
[Motor Detection]						
Motor Detection Amp Hysteresis Width			35	50	65	mV
CR Pin Threshold Voltage		V_{CR} changes from LOW to HIGH.	2.35	2.5	2.65	V
Thermal Shutdown Temperature	T_{SD}	(See note.)	150	180	210	°C
Thermal Shutdown Hysteresis	ΔT_{SD}	(See note.)		15		°C

Note : Values shown are design targets only. No measurements have been taken.

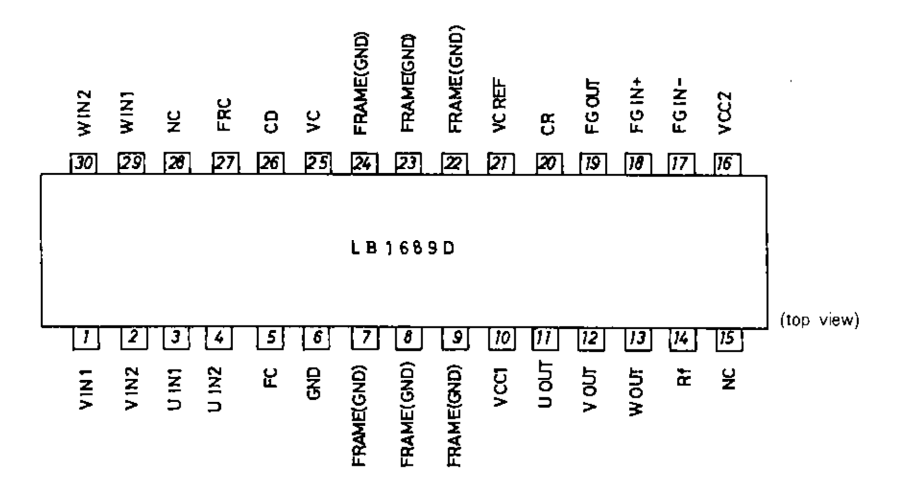
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Equivalent Circuit Block Diagram

0.01u
0.01u
0.01u
0.01u
+5V
12V
0.1u
Rf 0.47
0.047u x3
13 x3
DFF
Matrix FR
Amplitude control
TSR
Reference voltage
1.4V
VCC2
5V
Forward/reverse
Vc
VCREF
+5V
Rx
Cx
FG OUT
100k
220p
0.1u
0.01u
2k
1u
FG Coil
5V
LB1689D

Unit (resistance: Ω, capacitance: F)

Pin Assignment



Note : All FRAME pins are connected to GND.

Pin Description

Pin Name	Pin No.	Description
$U_{IN}1$, $U_{IN}2$ $V_{IN}1$, $V_{IN}2$ $W_{IN}1$, $W_{IN}2$	3, 4 1, 2 29, 30	U phase hall element input pin. 'H' of logic : $V_{IN}1 > V_{IN}2$ V phase hall element input pin. 'H' of logic : $V_{IN}1 > V_{IN}2$ W phase hall element input pin. 'H' of logic : $V_{IN}1 > V_{IN}2$
U_{OUT} V_{OUT} W_{OUT}	11 12 13	U phase output pin V phase output pin W phase output pin
$V_{CC}1$	10	Power supply pin for applying output
$V_{CC}2$	16	Power supply pin for applying voltage to each section other than output section. This voltage must be stabilized to be free from ripple, noise, etc.
Rf	14	Output current detect pin. By connecting Rf across this pin and GND pin, output current is detected as voltage. The result is used to control the overcurrent protection circuit.
CD	26	Pin for fetching current (voltage) detected with Rf. Takes feedback from Rf to reduce output voltage gain. Ground when not in use.
FC	5	Frequency characteristic correction
V_C	25	Speed-phase control pin Control is of voltage-controlled type that controls output voltage.
V_{CREF}	21	Control reference voltage
GND	6	GND for other than output Minimum potential of output transistor is at Rf pin.
F/RC	27	Forward/reverse control pin By setting this pin to 'H' (more than 2.0V)/'L' (less than 0.3V), truth value is changed to perform forward/reverse rotation.
FGin−, FGin+	17, 18	FG signal input pin
FG_{OUT}	19	FG amp output pin
CR	20	This pin voltage can be used to change the hall input-output gain. Connection of an external resistor and capacitor makes it possible to detect the rotational speed of a motor and change the hall input gain in two steps.

Truth Table

	Source → Sink	Input U	Input V	Input W	Forward/Reverse Control F/RC
1	W phase → V phase	H	H	L	L
	V phase → W phase				H
2	W phase → U phase	H	L	L	L
	U phase → W phase				H
3	V phase → W phase	L	L	H	L
	W phase → V phase				H
4	U phase → V phase	L	H	L	L
	V phase → U phase				H
5	V phase → U phase	H	L	H	L
	U phase → V phase				H
6	U phase → W phase	L	H	H	L
	W phase → U phase				H

Input:
- H: High level. One of the inputs should have a potential at least 0.2V higher than the other.
- L: Low level. One of the inputs should have a potential at least 0.2V lower than the other.

Forward/reverse control:
- H : 2.0 to $V_{CC}2$
- L : 0 to 0.3V